Studijní plán

Název plánu: Bachelor Specialization, Information Security, 2021

Sou ást VUT (fakulta/ústav/další): Fakulta informa ních technologií

Katedra:

Obor studia, garantovaný katedrou: Úvodní stránka

Garant oboru studia.:

Program studia: Informatics Typ studia: Bakalá ské prezen ní

P edepsané kredity: 155

Kredity z volitelných p edm t : 25 Kredity v rámci plánu celkem: 180

Poznámka k plánu: This version of the study plan is intended for students who have been enrolled for study from the academic year 2021/2022 into the full-time form of study of the bachelor's program. Guarantor:

prof. Ing. Róbert Lórencz, CSc., Email: robert.lorenz@fit.cvut.cz

Název bloku: Povinné p edm ty programu

Minimální po et kredit bloku: 110

Role bloku: PP

Kód skupiny: BIE-PP.21

Název skupiny: Compulsory Courses of Bachelor Study Program Informatics, version 2021

Podmínka kredity skupiny: V této skupin musíte získat 110 kredit

Podmínka p edm ty skupiny: V této skupin musíte absolvovat 21 p edm t

Kredity skupiny: 110

Poznámka ke

skupině:

If you plan to profile yourself in the specialization Information Security, Computer Networks and Internet, Computer Systems and Virtualization, or Software Engineering, enroll in the course BIE-PSI.21 in your 2nd semester of study. If you plan to profile yourself in the specialization Computer Engineering, or Computer Science, enroll in the course BI-PSI.21 in your 4th semester of study. - On the basis of the certificate of knowledge of English at the B2 level, which is stated in the conditions for admission to study,

you can have the subject BIE-EEC recognized for 4 credits.

Kód	Název p edm tu / Název skupiny p edm t (u skupiny p edm t seznam kód jejích len) Vyu ující, auto i a garanti (gar.)	Zakon ení	Kredity	Rozsah	Semestr	Role
BIE-AG1.21	Algorithms and Graphs 1 Jan Volec, Radek Hušek, Michal Opler, Dušan Knop, Ond ej Suchý, Tomáš Valla Dušan Knop Dušan Knop (Gar.)	Z,ZK	5	2P+2C	Z	PP
BIE-AAG.21	Automata and Grammars Jan Holub Jan Holub Jan Holub (Gar.)	Z,ZK	5	2P+2C	Z	PP
BIE-BPR.21	Bachelor Project Zden k Muziká Zden k Muziká (Gar.)	Z	1		Z,L	PP
BIE-BAP.21	Bachelor Thesis Zden k Muziká Zden k Muziká Zden k Muziká (Gar.)	Z	14		L,Z	PP
BIE-PSI.21	Computer Networks Yelena Trofimova, Michal Polák Yelena Trofimova Yelena Trofimova (Gar.)	Z,ZK	5	2P+1R+1C	L	PP
BIE-SAP.21	Computer Structures and Architectures Hana Kubátová, Petr Fišer Petr Fišer Petr Fišer (Gar.)	Z,ZK	5	2P+1R+2C	L	PP
BIE-KAB.21	Cryptography and Security Martin Jure ek, Filip Kodýtek, Josef Kokeš, Jaroslav K íž, Róbert Lórencz, Ji í Bu ek, Ivana Trummová, František Ková, David Pokorný Ji í Bu ek Róbert Lórencz (Gar.)	Z,ZK	5	2P+2C	L	PP
BIE-DBS.21	Database Systems Josef Pavlí ek, Otto Šleger, Martin Urbanec Josef Pavlí ek Josef Pavlí ek (Gar.)	Z,ZK	5	2P+2R+1L	L	PP
BIE-DML.21	Discrete Mathematics and Logic Eva Pernecká, Jitka Rybní ková, Francesco Dolce Eva Pernecká Eva Pernecká (Gar.)	Z,ZK	5	2P+1R+1C	Z	PP
BIE-TDP.21	Documentation and Presentation Dana Vynikarová Dana Vynikarová (Gar.)	KZ	3	2P+2C	Z,L	PP
BIE-EEC	English language external certificate Zden k Muziká Zden k Muziká Zden k Muziká (Gar.)	Z	4	2D	L	PP
BIE-LA1.21	Linear Algebra 1 Marzieh Forough Karel Klouda Marzieh Forough (Gar.)	Z,ZK	5	2P+1R+1C	Z	PP

BIE-MA1.21	Mathematical Analysis 1 Antonella Marchesiello Tomáš Kalvoda Tomáš Kalvoda (Gar.)	Z,ZK	5	2P+1R+1C	L	PP
BIE-MA2.21	Mathematical Analysis 2 Antonella Marchesiello Tomáš Kalvoda Antonella Marchesiello (Gar.)	Z,ZK	6	3P+2C	Z	PP
BIE-OSY.21	Operating Systems Michal Štepanovský, Jan Trdli ka, Pavel Tvrdík Pavel Tvrdík Pavel Tvrdík (Gar.)	Z,ZK	5	2P+1R+1L	L	PP
BIE-PST.21	Probability and Statistics Francesco Dolce Pavel Hrabák Francesco Dolce (Gar.)	Z,ZK	5	2P+2C	Z	PP
BIE-PA1.21	Programming and Algorithmics 1 Radek Hušek, Jan Trávní ek, Ladislav Vagner, Josef Vogel Jan Trávní ek Jan Trávní ek (Gar.)	Z,ZK	7	2P+2R+2C	Z	PP
BIE-PA2.21	Programming and Algorithmics 2 Radek Hušek, Jan Trávní ek, Ladislav Vagner, Josef Vogel Jan Trávní ek Jan Trávní ek (Gar.)	Z,ZK	7	2P+1R+2C	L	PP
BIE-GIT.21	SW Development Technologies Petr Pulc Petr Pulc (Gar.)	Z	3	2P	Z	PP
BIE-TZP.21	Technological Fundamentals of Computers Kate ina Hyniová, Martin Novotný, Matúš Olekšák Martin Novotný Martin Novotný (Gar.)	Z,ZK	5	2P+2C	Z	PP
BIE-UOS.21	Unix-like Operating Systems Jan Trdli ka, Jakub Žitný, Zden k Muziká Zden k Muziká (Gar.)	KZ	5	2P+2C	Z	PP

Charakteristiky p edmet této skupiny studijního plánu: Kód=BIE-PP.21 Název=Compulsory Courses of Bachelor Study Program Informatics, version 2021

BIF-AG1.21 Algorithms and Graphs 1 Z.ZK The course covers the basics from the efficient algorithm design, data structures, and graph theory, belonging to the core knowledge of every computing curriculum. It is interlinked with the concurrent BIE-AAG and BIE-ZDM courses in which the students gain the basic skills and knowledge needed for time and space complexity of algorithms and learn to handle practically the asymptotic mathematics. BIE-AAG.21 Automata and Grammars Students are introduced to basic theoretical and implementation principles of the following topics: construction, use and mutual transformations of finite automata, regular expressions and regular grammars, translation finite automata, construction and use of pushdown automata, hierarchy of formal languages, relationships between formal languages and automata. Knowledge acquired through the module is applicable in designs of algorithms for searching in text, data compression, simple parsing and translation, and design of digital circuits. BIE-BPR.21 **Bachelor Project** At the beginning of the semester the student will contact the supervisor of the bachelor thesis he has booked. They will discuss the partial tasks that student will perform during the semester. If he fulfill these tasks, the supervisor will award him / her at the end of the semester with the BI-BPR course. BIE-BAP.21 **Bachelor Thesis** 14 7 BIE-PSI.21 Computer Networks 5 Z,ZK The course introduces students to the principles of computer networking. It covers basic technologies, protocols, and services commonly used in local networks and in the Internet as well. The lectures will be amended by proseminars that introduce students into network programming and demonstrate the abilities of advanced network technologies. Students practically verify configurations and management of network devices in the lab within the environment of the operating systems Linux and Cisco IOS. Computer Structures and Architectures Students understand basic digital computer units and their structures, functions, and hardware implementation: ALU, control unit, memory system, inputs, outputs, data storage and transfer. In the labs, students gain practical experience with the design and implementation of the logic of a simple processor using modern digital design tools. BIE-KAB.21 Cryptography and Security 5 Students will understand the mathematical foundations of cryptography and gain an overview of current cryptographic algorithms. They will be able to use cryptographic keys and certificates in systems based on them and learn the basics of safe use of symmetric and asymmetric cryptographic systems and hash functions in applications. Within labs, students will gain practical skills in using standard cryptographic methods with an emphasis on security and will also get acquainted with the basic procedures of cryptanalysis. Students are expected to be competent programmers in C/C++ (on a small scale). Basic Python knowledge is an advantage. BIE-DBS.21 Database Systems Z.ZK Students get acquainted with the architecture of the database engine and typical user roles. They learn to design the structure of a smaller data store (including integrity constraints) using a conceptual model and then implement them in a relational database engine. They get acquainted with the SQL language and also with its theoretical basis - relational database model. They will get acquainted with the principles of relational database schema normalization. They understand the basic concepts of transaction processing and control of parallel user access to a single data source. At the end of the course, students will be introduced to alternative nonrelational database models. Discrete Mathematics and Logic Students will get acquainted with the basic concepts of propositional logic and predicate logic and learn to work with their laws. Necessary concepts from set theory will be explained. Special attention is paid to relations, their general properties, and their types, especially functional relations, equivalences, and partial orders. The course also lays down the basics of combinatorics and number theory, with emphasis on modular arithmetics. Documentation and Presentation The course is focused on the basics of creating electronic documentation with emphasis on the creation of technical reports of a larger scope, typically final university theses. Students learn to create text of a technical report in the LaTeX system, process an electronic presentation using the LaTeX Beamer system, and practically present it in front of classmates and the teacher. The course is intended primarily for those students who have chosen the topic of their bachelor's thesis or will choose it within the first 14 days of teaching. Within the exercises of the course, an active approach to the creation of individual parts of the bachelor's thesis is assumed. **BIE-EEC** English language external certificate Z The BIE-ECC course can be recognized for any active semester after the submission of a certificate certificate that demonstrates their proficiency in English comparable to or exceeding the B2 level of the Common European Framework of Reference for Languages. BIE-LA1.21 Linear Algebra 1 Z,ZK 5 We will introduce students to the basic concepts of linear algebra, such as vectors, matrices, vector spaces. We will define vector spaces over the field of real and complex numbers

and also over finite fields. We will present the concepts of basis and dimension and learn to solve systems of linear equations using the Gaussian elimination method (GEM) and show the connection with linear manifolds. We define the regularity of matrices and learn to find their inversions using GEM. We will also learn to find eigenvalues and eigenvectors of a

matrix. We will also demonstrate some applications of these concepts in computer science.

BIE-MA1.21 Mathematical Analysis 1

We begin the course by introducing students to the set of real numbers and its properties, and we note its differences with the set of machine numbers. Then we study real sequences and real functions of a real variable. We gradually introduce the notions of limits of sequences and functions, continuous functions, and derivatives of functions. This theoretical foundation is then applied to root-finding problems (iterative method of bisection and Newtons method), construction of cubic interpolation (spline), and formulation and solution of simple optimization problems (i.e., the issue of finding extrema of functions). The course is closed with the Landaus asymptotic notation and methods of mathematical description of complexity of algorithms.

BIE-MA2.21 Mathematical Analysis 2

Z,ZK

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The course completes the theme of analysis of real functions of a real variable initiated in BIE-MA1 by introducing the Riemann integral. Students will learn how to integrate by parts and use the substitution method. The next part of the course is devoted to number series, and Taylor polynomials and series. We apply Taylors theorem to the computation of elementary functions with a prescribed accuracy. Then we study the linear recurrence equations with constant coefficients, the complexity of recursive algorithms, and its analysis using the Master theorem. Finally, we introduce the student to the theory of multivariate functions. After establishing basic concepts of partial derivative, gradient, and Hessian matrix, we study the analytical method of localization of local extrema of multivariate functions as well as the numerical descent method. We conclude the course with the integration of multivariate functions.

BIE-OSY.21 Operating Systems

Z,ZK

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In this course that is a follow-up of the Unix-like operating systems course students deepen their knowledge in areas of OS kernels, process and thread implementations, race conditions, critical regions, thread scheduling, shared resource allocation and deadlocks, management of virtual memory and data storages, file systems, OS monitoring. They are able to design and implement simple multithreaded applications. General principles are illustrated on operating systems Solaris, Linux, or MS Windows.

BIE-PST.21 Probability and Statistics

Z,ZK

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Students will learn the basics of probabilistic thinking, the abile to synthesize prior and posterior information and learn to work with random variables. They will be able to apply basic models of random variable distributions and solve applied probabilistic problems in informatics and computer science. Using the statistical induction they will be able to perform estimations of unknown distributional parameters from random sample characteristics. They will also be introduced to the methods for testing statistical hypotheses and determining the statistical dependence of two or more random variables.

BIE-PA1.21 Programming and Algorithmics 1

Z,ZK

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Students learn to construct algorithms for solving basic problems and write them in the C language. They master data types (simple, pointers, structured), expressions, statements, and functions presented in C language. They understand the principle of recursion and basics of algorithm complexity analysis. They know fundamental algorithms for searching, sorting, and manipulating linked lists and trees.

BIE-PA2.21 Programming and Algorithmics 2

7 7K

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Students know the instruments of object-oriented programming and are able to use them for specifying and implementing abstract data types (stack, queue, enlargeable array, list, set, table). They learn these skills using the C++ programming language and are introduced to all C++ features needed in object-oriented programming (e.g., template programming, copying/moving of objects, operator overloading, inheritance, polymorphism).

BIE-GIT.21 SW Development Technologies

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This course is aimed at one of the rudimental team software development technology - version control. To be more specific, we will introduce students to Git, the information manager from hell, as Linus Torvalds nicknamed it, and provide a comprehensive guide into its depths, as well as for day-to-day use.

BIE-TZP.21 Technological Fundamentals of Computers

Z,ZK

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Students get acquainted with the fundamentals of digital and analog circuits, as well as basic methods of analyzing them. Students learn how computer structures look like at the lowest level. They are introduced to the function of a transistor. They will understand why processors generate heat, why cooling is necessary, and how to reduce the consumption; what the limits to the maximum operating frequency are and how to raise them; why a computer bus needs to be terminated, what happens if it is not; how a computer power supply looks like (in principle). In the labs, students model the behavior of basic electrical circuits in SW Mathematica.

BIE-UOS.21 Unix-like Operating Systems

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Unix-like operating systems represent a large family mostly open-source codes that kept bringing during the history of computers efficient innovative functions of multiuser operating systems for computers and their networks and clusters. The most popular OS today, Android, has a unix kernel. Students get overview of basic properties of this OS family, such as processes and threads, access rights and user identity, filters, or handling files in a file system. They learn to use practically these systems at the level of advanced users who are not only able to utilize powerful system tools that are available to users, but are also able to automatize routine agenda using the unix scripting interface, called shell.

Název bloku: Povinné p edm ty specializace

Minimální po et kredit bloku: 40

Role bloku: PS

Kód skupiny: BIE-IB-PS.21

Název skupiny: Compulsory Courses of Specialization Information Security, version 2021

Podmínka kredity skupiny: V této skupin musíte získat 40 kredit

Podmínka p edm ty skupiny: V této skupin musíte absolvovat 8 p edm t

Kredity skupiny: 40 Poznámka ke skupině:

Kód	Název p edm tu / Název skupiny p edm t (u skupiny p edm t seznam kód jejích len) Vyu ující, auto i a garanti (gar.)	Zakon ení	Kredity	Rozsah	Semestr	Role
BIE-ASB.21	Applied Network Security Yelena Trofimova, Ji í Dostál, Dominik Pastorek, František Ková, Gramoz Cubreli, Martin Šutovský Ji í Dostál Ji í Dostál (Gar.)	Z,ZK	5	2P+2C	Z	PS
BIE-APS.21	Architectures of Computer Systems Michal Štepanovský, Pavel Tvrdík Pavel Tvrdík Pavel Tvrdík (Gar.)	Z,ZK	5	2P+2C	Z	PS
BIE-ZSB.21	Basics of System Security Ji í Bu ek, Simona Forn sek, Martin Šutovský, Marián Svetlík Simona Forn sek Simona Forn sek (Gar.)	Z,ZK	5	2P+2C	Z	PS
BIE-EHA.21	Ethical Hacking Ji í Dostál, Andrej Simko, Martin Kolárik Ji í Dostál Ji í Dostál (Gar.)	Z,ZK	5	2P+2C	L	PS
BIE-HWB.21	Hardware Security Ji í Bu ek, Ond ej Staní ek Ji í Bu ek Ji í Bu ek (Gar.)	Z,ZK	5	2P+2C	Z	PS
BIE-UKB.21	Introduction to Cybersecurity Jan B Iohoubek, Ivana Trummová, David Pokorný, Jakub Tetera, Tomáš Rabas. Tomáš Lu ák Jan B Iohoubek Jan B Iohoubek (Gar.)	Z,ZK	5	3P+1C	Z	PS

BIE-BEK.21	Secure Code Josef Kokeš Josef Kokeš (Gar.)	Z,ZK	5	2P+2C	L	PS
BIE-ADU.21	Unix Administration Zden k Muziká, Petr Zemánek Petr Zemánek (Gar.)	Z,ZK	5	2P+2C	L	PS

Charakteristiky p edmet této skupiny studijního plánu: Kód=BIE-IB-PS.21 Název=Compulsory Courses of Specialization Information Security, version 2021

BIE-ASB.21 Applied Network Security

Z,ZK

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The aim of the course is to introduce selected topics from computer networks in terms of cybersecurity. These topics extend the basic knowledge gained in course BI-PSI with actual security applications like the public key infrastructure, encrypted network protocols, link and network layer security or wireless networks. After finishing the course student will get knowledge of security applications in computer networks.

BIE-APS.21 Architectures of Computer Systems

Z,ZK

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Students will learn the construction principles of internal architecture of computers with universal processors at the level of machine instructions. Special emphasis is given on the pipelined instruction processing and on the memory hierarchy. Students will understand the basic concepts of RISC and CISC architectures and the principles of instruction processing not only in scalar processors, but also in superscalar processors that can execute multiple instructions in one cycle, while ensuring the correctness of the sequential model of the program. The course further elaborates the principles and architectures of shared memory multiprocessor and multicore systems and the memory coherence and consistency in such systems.

BIE-ZSB.21 Basics of System Security

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The goal of the course is to provide introduction to basic concepts in security of computer systems. Further, the course introduces the basics of forensic analysis and related topics such as malware analysis or incident response. After finishing the course student will get both theoretical and practical knowledge in the area of modern operating systems security, as well as skills needed for independent work in the area of operating system security incident analysis.

BIE-EHA.21 Ethical Hacking

Z.ZK

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The goal of the course is to introduce students to the field of penetration testing and ethical hacking. The course deals with cybersecurity threats, vulnerabilities, and their possible exploitation in computer networks, web applications, wireless networks, operating systems, and others like the Internet of Things or cloud. The focus is on hands-on experience with vulnerabilities testing and the following process of penetration test documentation.

BIE-HWB.21 Hardware Security

Z,ZK

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The course deals with hardware resources used to ensure security of computer systems including embedded ones. Students become familiar with the operating principles of cryptographic modules, security features of modern processors, and storage media protection through encryption. They will gain knowledge about vulnerabilities of HW resources, including side-channel attacks and tampering with hardware during manufacture. Students will have an overview of contact and contactless smart card technology including applications and related topics for multi-factor authentication (biometrics). Students will understand methods of efficient implementations of ciphers. Students are expected to have basic knowledge of computer security and cryptography, and basic programming skills before enrolling into the course

BIE-UKB.21 Introduction to Cybersecurity

Z,ZK

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The goal of the course is to provide students with the introduction of basic concepts in modern approach to cybersecurity. Students will get a basic overview of threats in cyberspace and attacker techniques, security mechanisms in networks, operating systems and applications, as well as of basic cyberspace regulations.

BIE-BEK.21 Secure Code

Z,ZK

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The students will learn how to assess security risks and how to take them into account in the design phase of their own code and solutions. After getting familiar with the threat modeling theory, students gain practical experience with running programs with reduced privileges and methods of specifying these privileges, since not every program needs to run with administrator privileges. Dangers inherent in buffer overflows will be practically demonstrated. Students will be introduced to the principles of securing data and the relationships of security and database systems, web, remote procedure calls, and sockets in general. The module concludes with Denial of Service attacks and the defense against them.

BIE-ADU.21 Unix Administration

Z,ZK

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Students will learn the internal structure of the UNIX operating system, with the administration of its basic subsystems and with the security principles. They will understand the differences between user and administrator roles. They will get theoretical and practical knowledge of user management and administration, of users access rights, file systems, disk subsystems, processes, memory, network services and remote access, and in the areas of system deployment and virtualization. In the labs, they will verify the knowledge from the lectures on specific examples from practice.

Název bloku: Volitelné p edm ty oboru/specializace

Minimální po et kredit bloku: 0

Role bloku: VO

Kód skupiny: BIE-IB-VO.21

Název skupiny: Elective vocational Courses of the Bachelor Specialization Information Security, 2021

Podmínka kredity skupiny: Podmínka p edm ty skupiny:

Kredity skupiny: 0

Poznámka ke skupině:

Kód	Název p edm tu / Název skupiny p edm t (u skupiny p edm t seznam kód jejích len) Vyu ující, auto i a garanti (gar.)	Zakon ení	Kredity	Rozsah	Semestr	Role
BIE-SPS.21	Administration of Computer Networks and Services Libor Dostálek, Jan Kubr, Ond ej Slavík Pavel Tvrdík Libor Dostálek (Gar.)	Z,ZK	5	2P+2S	Z	VO
BIE-AG2	Algorithms and Graphs 2 Ond ej Suchý	Z,ZK	5	2P+2C	L	VO
BIE-ZUM.21	Artificial Intelligence Fundamentals Pavel Surynek Pavel Surynek (Gar.)	Z,ZK	5	2P+2C	L	VO
BIE-ZRS.21	Basics of System Control Kate ina Hyniová Kate ina Hyniová (Gar.)	Z,ZK	5	2P+2C	Z,L	VO
BIE-TPS.21	Computer Networks Technologies Vladimír Smotlacha, Josef Koumar Vladimír Smotlacha Vladimír Smotlacha (Gar.)	Z,ZK	5	2P+2C	Z	VO

BIE-JPO	Computer Units Pavel Kubalík	Z,ZK	5	2P+2C	Z	VO
BIE-KOM	Conceptual Modelling Robert Pergl	Z,ZK	5	2P+2C	Z	VO
BIE-VES	Embedded Systems Miroslav Skrbek	Z,ZK	5	2P+2C	L	VO
BIE-IOT.21	Internet of Things Pavel Tvrdík, Viktor erný, Lenka Kosková Tísková Lenka Kosková Tísková Lenka Kosková Tísková (Gar.)	Z,ZK	5	2P+2C	Z	VO
BIE-IDO.21	Introduction to DevOps Zden k Rybola, Tomáš Vondra, Jakub Jab rek Tomáš Vondra Zden k Rybola (Gar.)	Z,ZK	5	2P+2C	Z	vo
BIE-TJV.21	Java Technology Ond ej Rozinek Ond ej Rozinek (Gar.)	Z,ZK	5	2P+2C	Z	VO
BIE-LA2.21	Linear Algebra 2 Karel Klouda, Marzieh Forough Karel Klouda Karel Klouda (Gar.)	Z,ZK	5	2P+2C	L	VO
BIE-LOG.21	Mathematical Logic Kate ina Trlifajová Kate ina Trlifajová (Gar.)	Z,ZK	5	2P+2C	Z	VO
BIE-MPP.21	Methods of interfacing peripheral devices Miroslav Skrbek Miroslav Skrbek (Gar.)	Z,ZK	5	2P+2C	Z	VO
BIE-SIP.21	Network Programming Jan Fesl Jan Fesl (Gar.)	Z	5	2P+2C	Z	VO
BIE-OOP.21	Object-Oriented Programming Filip K ikava, Petr Máj, Filip íha Filip K ikava Filip K ikava (Gar.)	Z,ZK	5	2P+2C	Z	VO
BIE-PNO	Practical Digital Design Martin Novotný Martin Novotný (Gar.)	KZ	5	2P+2C	Z	VO
BIE-PJP	Programming Languages and Compilers Jan Janoušek	Z,ZK	5	2P+1C	L	VO
BIE-PPA	Programming Paradigms Petr Máj	Z,ZK	5	2P+2C	Z	VO
BIE-SRC.21	Real-time systems Hana Kubátová, Ji í Vysko il Hana Kubátová Hana Kubátová (Gar.)	Z,ZK	5	2P+2C	Z	VO
BIE-VPS.21	Selected Topics in Computer Networking Alexandru Moucha, Mohamed Bettaz Pavel Tvrdík Mohamed Bettaz (Gar.)	Z,ZK	5	2P+2C	L	VO
BIE-SWI.21	Software Engineering Stanislav Kuznetsov, Zden k Rybola, Jakub Jab rek, Ond ej Rozinek Zden k Rybola Zden k Rybola (Gar.)	Z,ZK	5	2P+1C	L	vo
BIE-SP1.21	Team Software Project 1 Stanislav Kuznetsov, Zden k Rybola, Jakub Jab rek, Ond ej Rozinek Zden k Rybola Zden k Rybola (Gar.)	KZ	5	4C	L	VO
BIE-SP2.21	Team Software Project 2 Stanislav Kuznetsov, Zden k Rybola, Michal Valenta, Jakub Jab rek, Ond ej Rozinek, Adéla Svítková Stanislav Kuznetsov Zden k Rybola (Gar.)	KZ	5	2C	Z	vo
BIE-VDC.21	Virtualization and Data Centers Ji í Kašpar Ji í Kašpar Ji í Kašpar (Gar.)	Z,ZK	5	2P+2C	L	VO
BIE-AWD.21	Web and Database Server Administration Michal Valenta, Lukáš Ba inka Lukáš Ba inka Michal Valenta (Gar.)	Z,ZK	5	2P+2C	Z	VO
	met této skupiny studijního plánu: Kód=BIE-IB-VO.21 Název=E	lective voca	tional C	ourses of	the Bach	elor
•	dministration of Computer Networks and Services			7	ZK	5
The aim of the course is to	deepen the theoretical knowledge of network technologies and protocols in the environmurse syllabus requires the knowledge at the level of courses BIE-PSI, BIE-VPS, and BIE-C			ninistrated und	der the opera	iting syste

The aim of the course is to deepen the theoretical knowledge of network technologies and protocols in the environment of network servers administrated under the operating systems Linux and Windows. The course syllabus requires the knowledge at the level of courses BIE-PSI, BIE-VPS, and BIE-OSY. Practical skills will be gained by practical hands-on experience with real network infrastructure. BIE-AG2 Algorithms and Graphs 2 Z,ZK 5 BIE-ZUM.21 Artificial Intelligence Fundamentals Z,ZK 5 Students are introduced to the fundamental problems in the Artificial Intelligence, and the basic methods for their solving. It focuses mainly on the classical tasks from the areas of state space search, multi-agent systems, game theory, planning, and machine learning. Modern soft-computing methods, including the evolutionary algorithms and the neural networks, will be presented as well. BIE-ZRS.21 Basics of System Control The course gives an introduction to the field of automatic control. It focuses particularly on the control of engineering and physical systems. It covers basic knowledge of the feedback control of linear dynamical single-input-single-output systems. Students will learn the methods of creating descriptions of system models, basic linear dynamic systems analysis, and design and verification of simple feedback PID, PSD, and fuzzy controllers. Attention is also given to sensors and actuators in control loops, issues of stability of control systems, single and continuous adjustment of the controller parameters, and certain aspects of the industrial implementations of continuous and digital controllers. BIE-TPS.21 Computer Networks Technologies The course introduces students with basic and advanced technologies, components, and interfaces of contemporary computer networks at the physical layer with the overlap to the link layer. The lectures provide theoretical foundations of these technologies and explain relevant physical principles. In the labs, the respective technologies will be demonstrated and with the most									
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BIF-KOM Conceptual Modelling The course focuses on the development of abstract thinking skills and precise specifications in the form of conceptual models. Students will learn the ability to distinguish key concepts in the domain, categorize and also determine the right links in complex systems of social reality, especially enterprises and institutions. Students will learn the basics of ontological structural modeling in OntoUML notation. They will also learn to express the rules and limitations of everyday reality using the OCL language. Students will also learn the basics of Enterprise Engineering as a discipline enabling conceptual modeling of the structure of enterprises and institutions and their process and learn the DEMO methodology. The course is also designed with regard to the continuity of software implementations. Embedded Systems Students learn to design embedded systems and develop software for them. They get basic knowledge of the most common microcontrollers and embedded processors, their integrated peripheral circuits, programming methods, and applications. They get practical skills with development kits and tools. BIE-IOT.21 Internet of Things Z,ZK 5 The course focuses on an overview of technologies and development tools used in the field of the Internet of Things (IoT). Lectures are devoted to an overview of sensors and actuators, wireless communication technologies designed primarily for this area, and appropriate programming methods. They include an overview of IoT architectures for different application areas. Within the computer labs, students will gain practical experience with developing simple IoT systems using common development environments (hardware - ARM, ESP, STM; software - Arduino, Raspberry Pi OS). BIE-IDO.21 Introduction to DevOps Z.ZK 5 The course deals with the topic of DevOps and prepares future developers and administrators for a modern culture of development and operation of systems and services. The course covers the tools to support software development, testing and compilation. It also focuses on tools for automating infrastructure management and building and deploying software to the Cloud. It is an introduction to technologies that will then be discussed in more detail in related follow-up courses. The student will also get acquainted with modern technologies used in practice. BIE-TJV.21 Java Technology The aim of the course is to provide knowledge and skills needed for the development of smaller and larger information systems. Students will get acquainted with general theoretical concepts and will be able to apply these concepts using libraries and tools from the ecosystem of the Java programming language. After completing the course students will be able to participate in the development of software systems on the Java platform. Students are assumed to be acquainted with the following topics (they are used and not taught in this course): Java language syntax, SQL, git version control system, Docker, continuous integration. BIE-LA2.21 Linear Algebra 2 Students will broaden their knowledge gained in the BIE-LA1 introductory course, where only vectors in the form of n-tuples of numbers were considered. Here we will introduce vector spaces in a general abstract form. The notions of a scalar product and a linear map will enable to demonstrate the profound link between linear algebra, geometry, and computer graphics. The other main topic will be numerical linear algebra, in particular problems with solving systems of linear equations on computers. The issues of numerical linear algebra will be demonstrated mainly on the matrix factorization problem. Selected applications of linear algebra in various fields will be presented. BIF-LOG.21 Mathematical Logic Z,ZK 5 The course focuses on the basics of propositional and predicate logic. It starts from the semantic point of view. Based on the notion of truth, satisfiability, logical equivalence, and the logical consequence of formulas are defined. Methods for determining the satisfiability of formulas, some of which are used for automated proving, are explained. This relates to the P vs. NP problem and Boolean functions in propositional logic. In predicate logic, the course further deals with formal theories, such as arithmetics, and their models. The syntactic approach to mathematical logic is demonstrated on the axiomatic system of propositional logic and its properties. Gödel's incompleteness theorems is explained. Methods of interfacing peripheral devices The course is focused on methods for interfacing of peripheral devices. Interfacing of real peripheral devices is focused on techniques based on Universal serial bus (USB). The course includes both PC side and peripheral devices side. Labs are practically oriented. Students gain experience with implementation of relevant parts of USB devices, Linux and Windows drivers, simple application development, and APIs of selected devices. BIE-SIP.21 **Network Programming** The course covers fundamental topics of programming network applications. It consists of 4 parts. The introductory part is focused on low-level programming using BSD sockets. The second part is devoted to designing communication protocols and their verification. The third part introduces the principles and applications of middleware technologies. The final part introduces basic modern models of distributed computing - P2P and blockchain. All topics will be first explained theoretically and then practices in computer labs using a chosen programming language environment. BIE-OOP.21 Object-Oriented Programming Object-oriented programming has been used in the last 50 years to solve computational problems by using graphs of objects that collaborate together by message passing. In this course students get acquainted with the main principles of object-oriented programming and design, used in modern programming languages. The emphasis is on practical techniques for developing software, which includes testing, error handing, refactoring, and application of design pattern. Practical Digital Design Students get an overview of the contemporary digital design flow and learn practical skills to use synchronous design techniques. They understand the basics of the VHDL language, and implementation technologies FPGA and ASIC. BIE-PJP Programming Languages and Compilers Z,ZK 5 Students master basic methods of implementation of common high-level programming languages. They get experience with the design and implementation of individual compiler parts for a simple programming language: data types, subroutines, and data abstractions. Students are able to formally specify a translation of a text that has a certain syntax into a target form and write a compiler based on such a specification. The notion of compiler in this context is not limited to compilers of programming languages, but extends to all other programs for parsing and processing text in a language defined by a LL(1) grammar. **BIE-PPA Programming Paradigms** Z.ZK 5 BIF-SRC 21 Real-time systems Students obtain the basic knowledge in the real-time (RT) system theory and in the design methods for RT systems including the dependability issues. Theoretical knowledge from lectures will be experimentally verified in department specialized labs. The course is mainly focused on embedded RT systems, therefore the design kits in the lab are the same as in the BIE-VES course and FPGAs. BIE-VPS.21 Selected Topics in Computer Networking The course builds upon the Computer Networks course (BI-PSI), obligatory for the program. Students will learn in detail principles, protocols, and technologies used in modern computer networks from local area networks up to Internet, with focus on switching, routing, security, and virtualization. The emphasis will be on gaining practical experience with real network devices in the lab and learning important methods of local area and wide area networks from the viewpoint of functionality, performance, and security. Software Engineering Students get acquainted with methods of analysis and design of larger software projects that are typically designed and implemented in teams. They consolidate and practically verify their knowledge during the analysis and design of larger software systems that will be developed in the concurrent course BIE-SP1. Students get hands-on experience with CASE tools using the visual language UML for modeling and solving software problems. Students learn the basics of object-oriented analysis, architecture design and testing. Within the course, students also gain a theoretical basis in the field of project management, estimation of costs of software projects, and methods of their development.

Team Software Project 1

Students gain hands-on experience with the analysis, design, and prototyping of a large-scale software system. Theoretical support is provided in the BIE-SWI course that runs concurrently and that teaches students necessary techniques and principles. Teams consisting of 4-6 students will work on a specific project. The teacher, in the role of the team and project leader, regularly consults with the team (at the seminars) both the formal and material aspects of the software design. The resulting software artefact will be further developed and finished in the BIE-SP2 course.

BIE-SP2.21 Team Software Project 2 ΚZ

Students gain hands-on experience with the iterative development process while working on a large-scale software project. The first iteration is the result of the BIE-SP1 course project. However, in this follow-up, the functionality, testing, and documentation of the software system being developed will be emphasized. Students will work in teams of 4-6 people. The teacher, in the role of the team and project leader, regularly consults with the team (at the seminars) the formal as well as material aspects of their solution

BIE-VDC.21 Virtualization and Data Centers Z,ZK

The aim of the course is to familiarize students with technology basis of cloud computer systems. It shows principles and techniques used in design and implementation of data center infrastructure, such as various kinds of virtualization and high availability of servers, storages, and software layers. The course guides through data center technologies from private to public and hybrid clouds. Student learn current trends in the architecture of IT infrastructure and its configuration for classic and cloud applications. Students will understand the design, validation, and operation of complex infrastructures for modern applications with respect to scalability and protection against overloads, outages, and data losses.

BIE-AWD.21 Web and Database Server Administration Z,ZK

Students will get acquainted with the administration of database and web servers and services. They will be able to install, configure, operate, test, and backup complex database and web service systems. The principles will be demonstrated on the PostgreSQL relational database engine and Apache will be used as an example of a web server.

Název bloku: Povinn volitelné p edm ty

Minimální po et kredit bloku: 5

Role bloku: PV

Kód skupiny: BIE-IB-PV.21

Název skupiny: Compulsory elective Courses of the Specialization Information Security, version 2021

Podmínka kredity skupiny: V této skupin musíte získat alespo 5 kredit (maximáln 15)

Podmínka p edm ty skupiny: V této skupin musíte absolvovat alespo 1 p edm t (maximáln 3)

Kredity skupiny: 5 Poznámka ke skupině:

Kód	Název p edm tu / Název skupiny p edm t (u skupiny p edm t seznam kód jejích len) Vyu ující, auto i a garanti (gar.)	Zakon ení	Kredity	Rozsah	Semestr	Role
BIE-TAB.21	Applications of Security in Technology Jan B Iohoubek, Ji í Dostál, Maciej Skórski, Martin Pozd na Ji í Dostál Ji í Dostál (Gar.)	Z,ZK	5	2P+2C	L	PV
BIE-ZUM.21	Artificial Intelligence Fundamentals Pavel Surynek Pavel Surynek (Gar.)	Z,ZK	5	2P+2C	L	PV
BIE-VES.21	Embedded Systems Miroslav Skrbek Miroslav Skrbek (Gar.)	Z,ZK	5	2P+2C	L	PV

Charakteristiky p edmet této skupiny studijního plánu: Kód=BIE-IB-PV.21 Název=Compulsory elective Courses of the Specialization Information Security, version 2021

BIE-ZUM.21 Artificial Intelligence Fundamentals Z.ZK

Students are introduced to the fundamental problems in the Artificial Intelligence, and the basic methods for their solving. It focuses mainly on the classical tasks from the areas of state space search, multi-agent systems, game theory, planning, and machine learning. Modern soft-computing methods, including the evolutionary algorithms and the neural networks, will be presented as well.

BIE-TAB.21 Applications of Security in Technology Z.ZK

5

The goal of the course is to introduce students to selected topics from cybersecurity technical applications that are utilized in different industries. Students get a broader overview of cybersecurity applications and extend their knowledge from the cryptology, the secure code, and system, network, and hardware security.

BIE-VES.21 **Embedded Systems** Z,ZK

Students learn to design embedded systems and develop software for them. They get basic knowledge of the most common microcontrollers and embedded processors, their integrated peripheral circuits, programming methods, and applications. They get practical skills with development kits and tools.

Název bloku: Volitelné p edm ty Minimální po et kredit bloku: 0

Role bloku: V

Kód skupiny: BIE-V.2021

Název skupiny: Purely Elective Bachelor Courses, Version 2021 till 2024/25

Podmínka kredity skupiny: Podmínka p edm ty skupiny:

Kredity skupiny: 0 Poznámka ke skupině:

Kód	Název p edm tu / Název skupiny p edm t (u skupiny p edm t seznam kód jejích len) Vyu ující, auto i a garanti (gar.)	Zakon ení	Kredity	Rozsah	Semestr	Role
BIE-ZUM	Artificial Intelligence Fundamentals Pavel Surynek	Z,ZK	4	2P+2C	L	V
BIE-ZRS	Basics of System Control Kate ina Hyniová	Z,ZK	4	2P+2C	L	V
BIE-CCN	Compiler Construction Christoph Kirsch Christoph Kirsch (Gar.)	Z,ZK	5	2P+1C	L	V
BIE-SCE1	Computer Engineering Seminar I Hana Kubátová, Miroslav Skrbek Hana Kubátová Hana Kubátová (Gar.)	Z	4	2C	Z	V
BIE-SCE2	Computer Engineering Seminar II Hana Kubátová, Ji í Vysko il Hana Kubátová Hana Kubátová (Gar.)	Z	4	2C	L	V
BIE-CZ0	Czech Language for Foreigners Tomáš Houdek, Jakub Šenovský, Markéta Hofmannová Zden k Muziká Zden k Muziká (Gar.)	KZ	2	4C	Z,L	V
BIE-CZ1.21	Czech Language for Foreigners II Tomáš Houdek, Jakub Šenovský, Markéta Hofmannová Zden k Muziká Zden k Muziká (Gar.)	KZ	2	4C	Z,L	V
UKCJP	eština pro pokro ilé Tomáš Houdek, Jakub Šenovský, Jakub Šolc, Adam Vostárek Zden k Muziká Zden k Muziká (Gar.)	Z,ZK	2	2BP+2BC	Z,L	V
BIE-DIF	Differential equations Tomáš Kalvoda	Z,ZK	5	2P+2C	L	V
BIE-EPR	Economic project Tomáš Evan Tomáš Evan (Gar.)	Z	1		L	V
BIE-FTR.1	Financial Markets Payla Vozárová	Z,ZK	5	2P+2C	L	V
BIE-HAS	Human Factors in Cryptography and Security Ivana Trummová Ivana Trummová Ivana Trummová (Gar.)	Z,ZK	5	2P+1C	Z	V
BIE-CSI	Introduction to Computer Science Christoph Kirsch Christoph Kirsch (Gar.)	Z	2	2C	Z	V
BIE-EHD	Introduction to European Economic History Tomáš Evan Tomáš Evan Tomáš Evan (Gar.)	Z,ZK	3	2P+1C	L	V
FITE-EHD	Introduction to European Economic History Tomáš Evan Tomáš Evan Tomáš Evan (Gar.)	Z,ZK	3	2P+1C	L	V
BIE-IMA	Introduction to Mathematics Karel Klouda	Z	4	3C	Z	V
BIE-IMA2	Introduction to Mathematics 2 Karel Klouda	Z	2	1C	Z	V
BIE-ST1	Network Technology 1 Alexandru Moucha Alexandru Moucha (Gar.)	Z	3	2C	Z	V
BIE-PKM	Preparatory Mathematics Jitka Rybni ková Tomáš Kalvoda (Gar.)	Z	4		Z	V
BIE-PJV	Programming in Java Jan Blizni enko Jan Blizni enko Jan Blizni enko (Gar.)	Z,ZK	4	2P+2C	Z	V
BIE-PS2	Programming in shell 2 Lukáš Ba inka	Z,ZK	4	2P+2C	L	V
FIT-ACM1	Programovací praktika 1 Tomáš Valla Tomáš Valla (Gar.)	KZ	5	4C	L	V
FIT-ACM2	Programovací praktika 2 Tomáš Valla Ond ej Suchý (Gar.)	KZ	5	4C	Z	V
FIT-ACM3	Programovací praktika 3	KZ	5	4C	L	V
FIT-ACM4	Ond ej Suchý Ond ej Suchý (Gar.) Programovací praktika 4	KZ	5	4C	Z	V
FIT-ACM5	Ond ej Suchý Ond ej Suchý (Gar.) Programovací praktika 5	KZ	5	4C	L	V
FIT-ACM6	Ond ej Suchý Ond ej Suchý (Gar.) Programovací praktika 6	KZ	5	4C	L	V
BIE-PRR.21	Ond ej Suchý Ond ej Suchý (Gar.) Project management	Z,ZK	5	2P+2C	Z,L	V
BIE-SKJ.21	David Pešek, Tomáš Šubrt David Pešek David Pešek (Gar.) Scripting Languages	z,zk	4	2P+2C	L	V
BIE-VAK.21	Jan Ž árek, Lukáš Ba inka Lukáš Ba inka Jan Ž árek (Gar.) Selected Combinatorics Applications	Z	3	2R	L	V
BIE-VMM	Michal Opler, Dušan Knop Michal Opler Michal Opler (Gar.) Selected Mathematical Methods	Z,ZK	4	2P+2C	L	V
BI-SCE1	Marzieh Forough Tomáš Kalvoda Tomáš Kalvoda (Gar.) Seminá po íta ového inženýrství l	_, Z	4	2C	L,Z	V
BIE-SEG	Hana Kubátová Hana Kubátová Hana Kubátová (Gar.) Systems Engineering	Z	0	2C	, Z	V
TVV	Christoph Kirsch Christoph Kirsch Christoph Kirsch (Gar.) T lesná výchova	Z	0	0+2	Z,L	V
TVV0	T lesná výchova 0	Z	0	0+2	Z,L	V
TV2K1	T lesná výchova 2	Z	1		L,Z	V

TVKLV	T lovýchovný kurz	Z	0	7dní	L	V
BIE-TUR.21	User Interface Design Jan Schmidt Jan Schmidt (Gar.)	Z,ZK	5	2P+2C	L	V
BIE-VR1.21	Virtual reality I Petr Klán Petr Klán Petr Klán (Gar.)	KZ	4	2P+2C	L,Z	V
BIE-ADW.1	Windows Administration Ji í Kašpar, Miroslav Prágl Miroslav Prágl (Gar.)	Z,ZK	4	2P+1C	Z	V
FITE-SEP	World Economy and Business Tomáš Evan Tomáš Evan Tomáš Evan (Gar.)	Z,ZK	4	2P+2C	Z	V
BIE-SEP	World Economy and Business Tomáš Evan Tomáš Evan Tomáš Evan (Gar.)	Z,ZK	4	2P+2C	Z	V
BIE-3DT.1	3D Printing Marek Žehra	KZ	4	3C	L	V

Charakteristiky p edmet této skupiny studijního plánu: Kód=BIE-V.2021 Název=Purely Elective Bachelor Courses, Version 2021 till 2024/25

2024/25	•	
BIE-ZUM Artificial Intelligence Fundamentals	Z,ZK	4
Students are introduced to the fundamental problems in the Artificial Intelligence, and the basic methods for their solving. It focuses mainly on the c	1 / 1	e areas of state
space search, multi-agent systems, game theory, planning, and machine learning. Modern soft-computing methods, including the evolutionary algi		
be presented as well.		
BIE-ZRS Basics of System Control	Z,ZK	4
Volitelný p edm t základy ízení systém je ur en pro všechny zájemce o aplikovanou informatiku v bakalá ském studiu. Alespo p ehledové znal	1	
budou pro naše absolventy jist konkuren ní výhodou a zhodnotí je bezesporu v pr myslové praxi. Studenti získají znalosti v dynamicky se rozvíji		
Zam íme se zejména na ízení inženýrských a fyzikálních sysém . Poskytneme vám základní informace z oblasti zp tnovazebního ízení lineárn	-	
systém . Seznámíme vás s metodami vytvá ení popisu a modelu systém , základní analýzou lineárních dynamických systém a návrhem a ov		
PID, PSD a fuzzy regulátor . Pozornost je v nována rovn ž sníma m a ak ním len m v regula ních obvodech, otázkám stability regula ních ob		
nastavování parametr regulátoru a n kterým aspekt m pr myslových realizací spojitých a íslicových regulátor . Jednotlivá témata p ednášek js		-
p íklad a praktických pr myslových realizací.	•	-
BIE-CCN Compiler Construction	Z,ZK	5
This is an introductory class on compiler construction for bachelor students in computer science. The goal of the class is to introduce basic princip	1 / 1	_
understand the design and implementation of programming languages. Seeing and actually understanding self-compilation is the overarching their	•	
BIE-SCE1 Computer Engineering Seminar I	7	4
The Seminar of Computer Engineering is a (s)elective course for students who want to deal with deeper topics of digital design, reliability and resistant		-
are approached individually within the subject. Each student or group of students solves some interesting topic with the selected supervisor. Part of		
articles and other professional literature and/or work in K. N laboratories. The capacity of the subject is limited by the possibilities of the seminar te		
semester.	acricis. The topics a	TO HOW IOI COOK
BIE-SCE2 Computer Engineering Seminar II	7	4
		•
The Seminar of Computer Engineering is a (s)elective course for students who want to deal with deeper topics of digital design, reliability and resistant and a standard an		
are approached individually within the subject. Each student or group of students solves some interesting topic with the selected supervisor. Part of	•	
articles and other professional literature and/or work in K N laboratories. The capacity of the subject is limited by the possibilities of the seminar to	acners. The topics a	re new for each
semester.	1/7	
BIE-CZ0 Czech Language for Foreigners	KZ	2
Course Czech for foreigners offers the basic topics of conversation: Introductions, Orientation, Shopping, Work / Study, Travel, Time, Family.		
BIE-CZ1.21 Czech Language for Foreigners II	KZ	2
The course is intended for Students of English programmes who have completed BIE-CZ0 course or have basic knowledge of the Czech languag		expands the
basic vocabulary and clarifies the structure of the Czech language structure with regard to the practical needs of Students residing in the Czech R		
UKCJP eština pro pokro ilé	Z,ZK	2
Kurz pokro ilé eštiny pro ukrajinské studenty, kte í mají status uprchlíka. Zkouška potvrdí znalost eštiny na úrovní B2 s platností pro VUT.		
BIE-DIF Differential equations	Z,ZK	5
This course provides a foundational overview of differential equations, starting with basic motivation and examples of ODEs and progressing to essei	ntial solution methods	s like separation
of variables. Key theorems on existence and uniqueness establish when solutions can be guaranteed. Linear and system-based ODEs are covered	d with methods like o	characteristic
polynomial analysis, followed by examples of non-linear models such as predator-prey and epidemiological models to showcase real-world applications and applications are such as predator-prey and epidemiological models to showcase real-world applications.	ations. Finally, an intr	oduction to
partial differential equations (PDEs) extends these concepts to multi-variable contexts. The course will also cover numerical methods for solving C	DEs and PDEs, inclu	uding implicit
and explicit Euler methods, Runge-Kutta methods, and finite element methods for both ODEs and PDEs.		
BIE-EPR Economic project	Z	1
This course is an extension of the course introduction to European Economic History (BIE-EHD).		
BIE-FTR.1 Financial Markets	Z,ZK	5
Financial sector has been deeply transformed in the recent years, which led to a development of structured financial products, a new point of view		
globalization of market activities. The need to use and properly apply mathematical and technical tools is emphasized. To manage their financial a		
from technical schools who have sufficient knowledge ICT and mathematics, and who have at the same time an understanding of the functioning	=	_
Markets course thus englobes both a description of financial markets and related economic theories, and an overview of mathematical and statist	ical tools used in this	field.
BIE-HAS Human Factors in Cryptography and Security	Z,ZK	5
P edm t je ur en student m, které zajímá nejen matematická a technická stránka v ci, ale i p emýšlení nad tím, jestli výsledný produkt bude použitel	1	
šífry po užívatele aplikací). Studenti budou moci využít nabyté v domosti z tohoto kurzu k návrhu, plánování a analýze svých vlastních projekt v		
zam ené na lov ka.		
BIE-CSI Introduction to Computer Science	Z	2
This is an introductory class on Elementary Computer Science for broad audiences: bachelor students in computer science, students majoring in o		-
science, high-school students, anybody with a background in basic math and the desire to understand the absolute basics of computer science. T		-
and relate basic principles of computer science for students to understand, early on, what computer science is, why things such as high-level programment.	_	
done the way they are, and even how, on a basic yet representative and practically relevant level. After taking the class, students are able to answ		
I done the way they are, and even new, on a basic yet representative and practically relevant level. After taking the class, students are able to answ	or mor just basic com	Parei solelice

questions but also questions about themselves such as which courses to take next and which books to follow up with, ideally realizing if they are interested in computer science more

than expected, or even less than before.

BIE-EHD	Introduction to European Economic History	Z,ZK	3
The course introduces a	a selection of themes from European economic history. It gives the student basic knowledge about forming of the global economic	omy through the o	description of the
,	s European countries have been dominant actors in this process it focuses predominantly on their roles in economic history.	J	
· ·	re fragmentation of the Middle Ages, from the destruction of WWII to the current affairs, the development of modern financial		•
	he detailed economic history of particular European countries but rather the impact of trade and the role of particular events,	institutions and o	organizations in
	will consist of a mixture of lectures and discussions.	7 71/	
FITE-EHD	Introduction to European Economic History	Z,ZK	3
	a selection of themes from European economic history. It gives the student basic knowledge about forming of the global econo s European countries have been dominant actors in this process it focuses predominantly on their roles in economic history.		-
	se fragmentation of the Middle Ages, from the destruction of WWII to the current affairs, the development of modern financial		
· · · · · · · · · · · · · · · · · · ·	he detailed economic history of particular European countries but rather the impact of trade and the role of particular events,		= -
	will consist of a mixture of lectures and discussions.		
BIE-IMA	Introduction to Mathematics	Z	4
Students refresh and ex	tend knowledge of elementary functions and their properties. Students understand basic mathematical principles and they a	re able to apply th	nem in particular
examples.			
BIE-IMA2	Introduction to Mathematics 2	Z	2
Students refresh and ex	ttend knowledge of elementary functions and their properties. Students understand basic mathematical principles and they a	re able to apply th	nem in particular
examples.			
BIE-ST1	Network Technology 1	Z	3
	získání základních znalosti z oblasti po íta ových sítí a praktických zkušeností se sí ovými technologiemi. P edm t odpovíd	a látce kurikula C	isco Netacad
<u> </u>	Ramp;S Introduction to Networks.		
BIE-PKM	Preparatory Mathematics	Z	4
	tory Mathematics is to help students revise the most important topics of high-school mathematics.	7 71	
BIE-PJV	Programming in Java	Z,ZK	4
-	ng in Java will introduce students to the object oriented programming in Java programming language. Beside of basics of Jav	a language the fu	ndamental APIS
•	especially data structures, files, GUI, networking, databases and concurrent APIs.	7 71/	
BIE-PS2	Programming in shell 2	Z,ZK	4 o dooper incidet
	overview of scripting languages, introduction into syntax, semantics, programming style, data structures, pros and cons. In a and some other particular scripting languages and will get practical experience with shell script programming. Note to Erasmu		
-	even very basic Bourne shell usage. Depending on actual knowledge of the students, orientation in user filesystem tools (cp.		
•	tr, sort, uniq) can be provided. The advantage of this module is that we do not stop at this point - we will show you also a se		
techniques used in prac			
FIT-ACM1	Programovací praktika 1	KZ	5
Tento výb rový kurz má	za cíl p ipravit ty nejlepší studenty na reprezentaci fakulty v rámci mezinárodních ACM sout ží.		I
FIT-ACM2	Programovací praktika 2	KZ	5
Tento výb rový kurz má	za cíl p ipravit ty nejlepší studenty na reprezentaci fakulty v rámci mezinárodních ACM sout ží.		
FIT-ACM3	Programovací praktika 3	KZ	5
Tento výb rový kurz má	za cíl p ipravit ty nejlepší studenty na reprezentaci fakulty v rámci mezinárodních ACM sout ží.		•
FIT-ACM4	Programovací praktika 4	KZ	5
Tento výb rový kurz má	za cíl p ipravit ty nejlepší studenty na reprezentaci fakulty v rámci mezinárodních ACM sout ží.		
FIT-ACM5	Programovací praktika 5	KZ	5
	za cíl p ipravit ty nejlepší studenty na reprezentaci fakulty v rámci mezinárodních ACM sout ží.		
FIT-ACM6	Programovací praktika 6	KZ	5
	za cíl p ipravit ty nejlepší studenty na reprezentaci fakulty v rámci mezinárodních ACM sout ží.		
BIE-PRR.21	Project management	Z,ZK	5
	s to introduce students into the basic concepts and principles of project management, i.e. methods of planning, teamwork, ar	=	-
	argumentation and meeting management. Students will practice project management techniques (e.g. SWOT analysis, risk		-
	schedule, resource balancing, network graphs) and creation of project documentation. The course is designed especially for a dge outside IT, consider starting their own company, or have ambitions to work in middle or senior management positions in I		
	e who will develop software or hardware in the form of team projects.	arge companies.	THE COURSE IS
BIE-SKJ.21	Scripting Languages	Z,ZK	4
	e world of scripted programming. Together, we will unveil the power of Bourne Again shell and PERL as proven industry stand	•	· ·
	g utilities (AWK, sed), with some basic UNIX system tools, in many real-world situations like processing web feeds or logs. W		-
of scripting languages a	and introduction into their pros and cons and students get practical experience with shell script programming. We will touch all	so ROFF, PerlDo	c, and even TeX
to get some insight into	how your code documentation can be implemented. And if you know UNIX system-level scripting already, we can show you a	dvanced program	ming techniques
_	poked frequently but increase code robustness or execution efficiency. The course is led by two veteran programmers in the sc		
	ell programming, teaching developers from the IT industry in several CE countries. Jan is a skilled lecturer and developer whe	ose code contribu	ites to safe and
•	f cloud service datacenters around the globe.		
BIE-VAK.21	Selected Combinatorics Applications	Z	3
	oduce students in an accessible form to various branches of theoretical computer science and combinatorics. In contrast to th to theory. Together, we will first refresh the basic knowledge needed to design and analyze algorithms and introduce some b		
	tion of students, we will focus on solving popular and easily formulated problems from various areas of (not only theoretical)		
•	be solved will include, for example, graph theory, combinatorial and algorithmic game theory, approximation algorithms, optim		
•	olutions to the studied problems with a special focus on the effective use of existing tools.		
BIE-VMM	Selected Mathematical Methods	Z,ZK	4
	an introduction to the analysis of complex functions of a complex variable. Next, we present the Lebesgue integral. We then	,	· ·
properties. Further, we i	introduce and study the properties of the Discrete Fourier Transform (DFT) and its fast implementation (FFT). We discuss the	wavelet transform	n. We examine
the linear programming	problem in more detail and its solution using the Simplex algorithm. Each topic is demonstrated with interesting examples.		
BI-SCE1	Seminá po íta ového inženýrství l	Z	4
•	nženýrství je výb rový p edm t pro studenty, kte í se cht jí zabývat hloub ji tématy íslicového návrhu, spolehlivosti a odoln		
•	edm tu p istupuje individuáln a každý student i skupinka student eší n jaké zajímavé aktuální téma s vybraným školitel	em. Sou ástí p e	dm tu je práce s
v deckými lánky a jino nová.	u odbornou literaturou a/nebo práce v laborato ích K N. Kapacita p edm tu je omezena možnostmi u itel seminá e. Probíra	ná témata jsou pr	o každý semestr

BIE-SEG	Systems Engineering	Ζ	0
This is an introductory of	lass on systems engineering for bachelor students in computer science. The goal of the class is to introduce basic principles	of operating syste	ems for students
to understand processo	r and memory virtualization. Seeing and actually understanding virtualization is the overarching theme of the class. After takir	ng the class, stud	ents are able to
	be between processes and threads as well as emulation and virtualization, what virtual memory is and how it works, what cor	ncurrency is, as o	pposed to
parallelism, and how pro	ocesses and threads synchronize efficiently to overcome concurrency for communication.		
TVV	T lesná výchova	Z	0
TVV0	T lesná výchova 0	Z	0
TV2K1	T lesná výchova 2	Z	1
TVKLV	T lovýchovný kurz	Z	0
BIE-TUR.21	User Interface Design	Z,ZK	5
Students gain a basic o	verview of methods for designing and testing common user interfaces. They get experience to solve the problems where soft	ware and other pr	oducts do not
communicate with the u	ser optimally, since the needs and characteristics of users are not taken into account during product development. Students (gain an overview	of methods that
bring users into the dev	elopment process to ensure optimal interface for them.		
BIE-VR1.21	Virtual reality I	KZ	4
Introduction to Virtual R	eality (VR), virtual reality operations, metaverse, and creation. Rules and requirements for virtual worlds communication. The	course focuses of	n the ways of
creating virtual reality w	orlds and interactive activities in 3D worlds. It improves computational thinking, empathy, and shared social activities.		
BIE-ADW.1	Windows Administration	Z,ZK	4
Students understand th	e architecture and internals of the Windows OS and acquire the skills to administrate the Windows OS. They are able use the	standard adminis	stration and
security tools and apply	advanced ActiveDirectory administration methods. They are able to solve problems by applying appropriate troubleshooting	methods and adm	ninistrate
heterogeneous systems	s. Students are able to effectively configure centralised administration of a computer network.		
FITE-SEP	World Economy and Business	Z,ZK	4
The course introduces s	students of technical universities to international business. It does that predominantly by comparing individual countries and k	ey regions of the	world economy.
Students get to know at	out different religions and cultures, necessary for doing business in diverse societies as well as indexes of economic freedon	n, corruption and	economic
development, which are	needed for the right investment decision. Seminars help to improve knowledge in the form of discussions based on individual	I readings.	
BIE-SEP	World Economy and Business	Z,ZK	4
The course introduces s	tudents of technical universities to international business. It does that predominantly by comparing individual countries and k	ey regions of the	world economy.
Students get to know at	out different religions and cultures, necessary for doing business in diverse societies as well as indexes of economic freedon	n, corruption and	economic
development, which are	needed for the right investment decision. Seminars help to improve knowledge in the form of discussions based on individual	I readings.	
BIE-3DT.1	3D Printing	KZ	4
Students learn to design	n three-dimensional objects optimized for printing on a RepRap printer and the printing itself. They will be able to design object	cts, prepare for pr	inting and print
in 3D.			

Seznam p edm t tohoto pr chodu:

Zakon ení Kredity

Název p edm tu

Kód

BI-SCE1	Seminá po íta ového inženýrství I	Z	4
Seminá po íta ov	Pého inženýrství je výb rový p edm t pro studenty, kte í se cht jí zabývat hloub ji tématy íslicového návrhu, spolehlivosti a odolnost	i proti poruchám a	útok m. Ke
student m se v rán	nci p edm tu p istupuje individuáln a každý student i skupinka student eší n jaké zajímavé aktuální téma s vybraným školitelem.	. Sou ástí p edm	tu je práce s
v deckými lánky a	a jinou odbornou literaturou a/nebo práce v laborato ích K N. Kapacita p edm tu je omezena možnostmi u itel seminá e. Probíraná	témata jsou pro ka	ždý semestr
	nová.		
BIE-3DT.1	3D Printing	KZ	4
Students learn to d	design three-dimensional objects optimized for printing on a RepRap printer and the printing itself. They will be able to design objects in 3D.	, prepare for printi	ng and print
BIE-AAG.21	Automata and Grammars	Z,ZK	5
Students are introd	uced to basic theoretical and implementation principles of the following topics: construction, use and mutual transformations of finite	automata, regular	expressions
and regular gramm	ars, translation finite automata, construction and use of pushdown automata, hierarchy of formal languages, relationships between fo	rmal languages an	id automata.
Knowledge acqui	red through the module is applicable in designs of algorithms for searching in text, data compression, simple parsing and translation,	and design of digi	ital circuits.
BIE-ADU.21	Unix Administration	Z,ZK	5
Students will learn t	the internal structure of the UNIX operating system, with the administration of its basic subsystems and with the security principles. They	will understand the	e differences
between user and	administrator roles. They will get theoretical and practical knowledge of user management and administration, of users access rights,	file systems, disk	subsystems,
processes, memo	ory, network services and remote access, and in the areas of system deployment and virtualization. In the labs, they will verify the kno	owledge from the I	ectures on
	specific examples from practice.		
BIE-ADW.1	Windows Administration	Z,ZK	4
Students unders	tand the architecture and internals of the Windows OS and acquire the skills to administrate the Windows OS. They are able use the	standard administ	ration and
security tools a	nd apply advanced ActiveDirectory administration methods. They are able to solve problems by applying appropriate troubleshooting	methods and adm	ninistrate
	heterogeneous systems. Students are able to effectively configure centralised administration of a computer network.		
BIE-AG1.21	Algorithms and Graphs 1	Z,ZK	5
The course cover	s the basics from the efficient algorithm design, data structures, and graph theory, belonging to the core knowledge of every computi	ng curriculum. It is	interlinked
with the concurrent	BIE-AAG and BIE-ZDM courses in which the students gain the basic skills and knowledge needed for time and space complexity of	algorithms and lea	ırn to handle
	practically the asymptotic mathematics.		
BIE-AG2	Algorithms and Graphs 2	Z,ZK	5
BIE-APS.21	Architectures of Computer Systems	Z,ZK	5
Students will lear	in the construction principles of internal architecture of computers with universal processors at the level of machine instructions. Spec	cial emphasis is gi	ven on the
pipelined instructio	n processing and on the memory hierarchy. Students will understand the basic concepts of RISC and CISC architectures and the princ	ciples of instruction	n processing

not only in scalar processors, but also in superscalar processors that can execute multiple instructions in one cycle, while ensuring the correctness of the sequential model of the

program. The cours	se further elaborates the principles and architectures of shared memory multiprocessor and multicore systems and the memory coher systems.	rence and consiste	ency in such
BIE-ASB.21	Applied Network Security	Z,ZK	5
	rse is to introduce selected topics from computer networks in terms of cybersecurity. These topics extend the basic knowledge gaine		
security applicati	ons like the public key infrastructure, encrypted network protocols, link and network layer security or wireless networks. After finishing knowledge of security applications in computer networks.	j the course stude	ni wili get
BIE-AWD.21	Web and Database Server Administration	Z,ZK	5
-	quainted with the administration of database and web servers and services. They will be able to install, configure, operate, test, and be		
	ice systems. The principles will be demonstrated on the PostgreSQL relational database engine and Apache will be used as an exam	-	
BIE-BAP.21	Bachelor Thesis	Z 77/	14
BIE-BEK.21 The students will le	Secure Code arn how to assess security risks and how to take them into account in the design phase of their own code and solutions. After getting fa	Z,ZK	5 eat modeling
	gain practical experience with running programs with reduced privileges and methods of specifying these privileges, since not every		- 1
•	ileges. Dangers inherent in buffer overflows will be practically demonstrated. Students will be introduced to the principles of securing		
	database systems, web, remote procedure calls, and sockets in general. The module concludes with Denial of Service attacks and th	e defense against	
BIE-BPR.21	Bachelor Project of the semester the student will contact the supervisor of the bachelor thesis he has booked. They will discuss the partial tasks that st	Udant will parform	during the
At the beginning t	semester. If he fulfill these tasks, the supervisor will award him / her at the end of the semester with the BI-BPR course.	udent will penonn	during the
BIE-CCN	Compiler Construction	Z,ZK	5
This is an introdu	uctory class on compiler construction for bachelor students in computer science. The goal of the class is to introduce basic principles		udents to
	nd the design and implementation of programming languages. Seeing and actually understanding self-compilation is the overarching	theme of the class	
BIE-CSI	Introduction to Computer Science	Z	2
	ory class on Elementary Computer Science for broad audiences: bachelor students in computer science, students majoring in other fie ool students, anybody with a background in basic math and the desire to understand the absolute basics of computer science. The go		-
	rinciples of computer science for students to understand, early on, what computer science is, why things such as high-level programm		
	are, and even how, on a basic yet representative and practically relevant level. After taking the class, students are able to answer no	-	
questions but also	questions about themselves such as which courses to take next and which books to follow up with, ideally realizing if they are interes	ted in computer so	cience more
BIE-CZ0	than expected, or even less than before.	KZ	2
DIE-CZU	Czech Language for Foreigners Course Czech for foreigners offers the basic topics of conversation: Introductions, Orientation, Shopping, Work / Study, Travel, Time		2
BIE-CZ1.21	Czech Language for Foreigners II	KZ	2
	nded for Students of English programmes who have completed BIE-CZ0 course or have basic knowledge of the Czech language. The		kpands the
BIE-DBS.21	vocabulary and clarifies the structure of the Czech language structure with regard to the practical needs of Students residing in the Czech language structure with regard to the practical needs of Students residing in the Czech language structure with regard to the practical needs of Students residing in the Czech language structure with regard to the practical needs of Students residing in the Czech language structure with regard to the practical needs of Students residing in the Czech language structure with regard to the practical needs of Students residing in the Czech language structure with regard to the practical needs of Students residing in the Czech language structure with regard to the practical needs of Students residing in the Czech language structure with regard to the practical needs of Students residing in the Czech language structure with regard to the practical needs of Students residing in the Czech language structure with regard to the practical needs of Students residing in the Czech language structure with regard to the practical needs of Students residing in the Czech language structure with regard to the practical needs of Students residing in the Czech language structure with regard to the practical needs of Students residing in the Czech language structure with residing in the Czech language structure with residing in the Czech language structure with residence and residence structure with residen	Z,ZK	5
	ainted with the architecture of the database engine and typical user roles. They learn to design the structure of a smaller data store (i	,	
using a conceptual	model and then implement them in a relational database engine. They get acquainted with the SQL language and also with its theoret	cal basis - relation	al database
model. They will ge	et acquainted with the principles of relational database schema normalization. They understand the basic concepts of transaction produced to the principle of the the princip	_	ol of parallel
BIE-DIF	user access to a single data source. At the end of the course, students will be introduced to alternative nonrelational database m Differential equations	Z,ZK	5
	is a foundational overview of differential equations, starting with basic motivation and examples of ODEs and progressing to essential sc		
of variables. Key t	heorems on existence and uniqueness establish when solutions can be guaranteed. Linear and system-based ODEs are covered wit	h methods like cha	aracteristic
	sis, followed by examples of non-linear models such as predator-prey and epidemiological models to showcase real-world application	-	
partial differential	equations (PDEs) extends these concepts to multi-variable contexts. The course will also cover numerical methods for solving ODEs and explicit Euler methods, Runge-Kutta methods, and finite element methods for both ODEs and PDEs.	and PDEs, include	ing implicit
BIE-DML.21	Discrete Mathematics and Logic	Z,ZK	5
	equainted with the basic concepts of propositional logic and predicate logic and learn to work with their laws. Necessary concepts from		'
Special attention is	paid to relations, their general properties, and their types, especially functional relations, equivalences, and partial orders. The cours	e also lays down tl	he basics of
DIE 550	combinatorics and number theory, with emphasis on modular arithmetics.		
BIE-EEC	English language external certificate se can be recognized for any active semester after the submission of a certificate certificate that demonstrates their proficiency in Englis	Z ch comparable to c	4
THE BIL-LCC Cours	the B2 level of the Common European Framework of Reference for Languages.	sii comparable to c	n exceeding
BIE-EHA.21	Ethical Hacking	Z,ZK	5
The goal of the co	purse is to introduce students to the field of penetration testing and ethical hacking. The course deals with cybersecurity threats, vulnity		
exploitation in com	nputer networks, web applications, wireless networks, operating systems, and others like the Internet of Things or cloud. The focus is	on hands-on expe	rience with
DIE EUD	vulnerabilities testing and the following process of penetration test documentation.	7 7K	3
BIE-EHD The course introduce	Introduction to European Economic History ces a selection of themes from European economic history. It gives the student basic knowledge about forming of the global economy	Z,ZK through the descr	
	ds. As European countries have been dominant actors in this process it focuses predominantly on their roles in economic history. Fro	-	
-	re to the fragmentation of the Middle Ages, from the destruction of WWII to the current affairs, the development of modern financial in	· · · · · · · · · · · · · · · · · · ·	
course does not co	over the detailed economic history of particular European countries but rather the impact of trade and the role of particular events, ins history. Class meetings will consist of a mixture of lectures and discussions.	stitutions and orga	nizations in
BIE-EPR	Economic project	Z	1
DIE 21 11	This course is an extension of the course Introduction to European Economic History (BIE-EHD).	_	
BIE-FTR.1	Financial Markets	Z,ZK	5
	has been deeply transformed in the recent years, which led to a development of structured financial products, a new point of view on		
•	rket activities. The need to use and properly apply mathematical and technical tools is emphasized. To manage their financial activitie ools who have sufficient knowledge ICT and mathematics, and who have at the same time an understanding of the functioning of fin		١ .
	e thus englobes both a description of financial markets and related economic theories, and an overview of mathematical and statistic		
BIE-GIT.21	SW Development Technologies	Z	3
	· · · · · · · · · · · · · · · · · · ·		
This course is aime	ed at one of the rudimental team software development technology - version control. To be more specific, we will introduce students to from hell, as Linus Torvalds nicknamed it, and provide a comprehensive guide into its depths, as well as for day-to-day use		on manager

BIE-HAS Human Factors in Cryptography and Security Z,ZK 5 P edm t je ur en student m, které zajímá nejen matematická a technická stránka v ci, ale i p emýšlení nad tím, jestli výsledný produkt bude použitelný pro lidi (od t ch, kte í implementují šifry po uživatele aplikací). Studenti budou moci využít nabyté v domosti z tohoto kurzu k návrhu, plánování a analýze svých vlastních projekt v kontextu kybernetické bezpe nosti zam ené na lov ka. BIE-HWB.21 Z,ZK Hardware Security The course deals with hardware resources used to ensure security of computer systems including embedded ones. Students become familiar with the operating principles of cryptographic modules, security features of modern processors, and storage media protection through encryption. They will gain knowledge about vulnerabilities of HW resources, including side-channel attacks and tampering with hardware during manufacture. Students will have an overview of contact and contactless smart card technology including applications and related topics for multi-factor authentication (biometrics). Students will understand methods of efficient implementations of ciphers. Students are expected to have basic knowledge of computer security and cryptography, and basic programming skills before enrolling into the course BIE-IDO.21 Introduction to DevOps The course deals with the topic of DevOps and prepares future developers and administrators for a modern culture of development and operation of systems and services. The course covers the tools to support software development, testing and compilation. It also focuses on tools for automating infrastructure management and building and deploying software to the Cloud. It is an introduction to technologies that will then be discussed in more detail in related follow-up courses. The student will also get acquainted with modern technologies used in practice. **BIE-IMA** Introduction to Mathematics Ζ 4 Students refresh and extend knowledge of elementary functions and their properties. Students understand basic mathematical principles and they are able to apply them in particular BIF-IMA2 Introduction to Mathematics 2 Students refresh and extend knowledge of elementary functions and their properties. Students understand basic mathematical principles and they are able to apply them in particular examples. Z,ZK BIE-IOT.21 Internet of Things 5 The course focuses on an overview of technologies and development tools used in the field of the Internet of Things (IoT). Lectures are devoted to an overview of sensors and actuators, wireless communication technologies designed primarily for this area, and appropriate programming methods. They include an overview of IoT architectures for different application areas. Within the computer labs, students will gain practical experience with developing simple IoT systems using common development environments (hardware - ARM, ESP, STM; software - Arduino, Raspberry Pi OS). **BIE-JPO** Computer Units Students are acquainted with the internal structure and organization of computer units and their interfacing with the environment. They also learn the organization of various memory types (main memory, LIFO, FIFO and CAM), design methodology of control units and basic principles of bus communication. Students get skills needed for computer engineers. BIE-KAB.21 Cryptography and Security Students will understand the mathematical foundations of cryptography and gain an overview of current cryptographic algorithms. They will be able to use cryptographic keys and certificates in systems based on them and learn the basics of safe use of symmetric and asymmetric cryptographic systems and hash functions in applications. Within labs, students will gain practical skills in using standard cryptographic methods with an emphasis on security and will also get acquainted with the basic procedures of cryptanalysis. Students are expected to be competent programmers in C/C++ (on a small scale). Basic Python knowledge is an advantage. **BIE-KOM** Conceptual Modelling Z,ZK 5 The course focuses on the development of abstract thinking skills and precise specifications in the form of conceptual models. Students will learn the ability to distinguish key concepts in the domain, categorize and also determine the right links in complex systems of social reality, especially enterprises and institutions. Students will learn the basics of ontological structural modeling in OntoUML notation. They will also learn to express the rules and limitations of everyday reality using the OCL language. Students will also learn the basics of Enterprise Engineering as a discipline enabling conceptual modeling of the structure of enterprises and institutions and their process and learn the DEMO methodology. The course is also designed with regard to the continuity of software implementations. BIE-LA1.21 Linear Algebra 1 Z,ZK 5 We will introduce students to the basic concepts of linear algebra, such as vectors, matrices, vector spaces. We will define vector spaces over the field of real and complex numbers and also over finite fields. We will present the concepts of basis and dimension and learn to solve systems of linear equations using the Gaussian elimination method (GEM) and show the connection with linear manifolds. We define the regularity of matrices and learn to find their inversions using GEM. We will also learn to find eigenvalues and eigenvectors of a matrix. We will also demonstrate some applications of these concepts in computer science. Z,ZKBIE-LA2.21 Linear Algebra 2 5 Students will broaden their knowledge gained in the BIE-LA1 introductory course, where only vectors in the form of n-tuples of numbers were considered. Here we will introduce vector spaces in a general abstract form. The notions of a scalar product and a linear map will enable to demonstrate the profound link between linear algebra, geometry, and computer graphics. The other main topic will be numerical linear algebra, in particular problems with solving systems of linear equations on computers. The issues of numerical linear algebra will be demonstrated mainly on the matrix factorization problem. Selected applications of linear algebra in various fields will be presented. BIE-LOG.21 Mathematical Logic The course focuses on the basics of propositional and predicate logic. It starts from the semantic point of view. Based on the notion of truth, satisfiability, logical equivalence, and the logical consequence of formulas are defined. Methods for determining the satisfiability of formulas, some of which are used for automated proving, are explained. This relates to the P vs. NP problem and Boolean functions in propositional logic. In predicate logic, the course further deals with formal theories, such as arithmetics, and their models. The syntactic approach to mathematical logic is demonstrated on the axiomatic system of propositional logic and its properties. Gödel's incompleteness theorems is explained. BIE-MA1.21 Mathematical Analysis 1 Z.ZK We begin the course by introducing students to the set of real numbers and its properties, and we note its differences with the set of machine numbers. Then we study real sequences and real functions of a real variable. We gradually introduce the notions of limits of sequences and functions, continuous functions, and derivatives of functions. This theoretical foundation is then applied to root-finding problems (iterative method of bisection and Newtons method), construction of cubic interpolation (spline), and formulation and solution of simple optimization problems (i.e., the issue of finding extrema of functions). The course is closed with the Landaus asymptotic notation and methods of mathematical description of complexity of algorithms. BIE-MA2.21 Mathematical Analysis 2 Z,ZK The course completes the theme of analysis of real functions of a real variable initiated in BIE-MA1 by introducing the Riemann integral. Students will learn how to integrate by parts and use the substitution method. The next part of the course is devoted to number series, and Taylor polynomials and series. We apply Taylors theorem to the computation of elementary functions with a prescribed accuracy. Then we study the linear recurrence equations with constant coefficients, the complexity of recursive algorithms, and its analysis using the Master theorem. Finally, we introduce the student to the theory of multivariate functions. After establishing basic concepts of partial derivative, gradient, and Hessian matrix, we study the analytical method of localization of local extrema of multivariate functions as well as the numerical descent method. We conclude the course with the integration of multivariate functions. BIE-MPP.21 Methods of interfacing peripheral devices 5 The course is focused on methods for interfacing of peripheral devices. Interfacing of real peripheral devices is focused on techniques based on Universal serial bus (USB). The course includes both PC side and peripheral devices side. Labs are practically oriented. Students gain experience with implementation of relevant parts of USB devices, Linux and Windows drivers, simple application development, and APIs of selected devices.

BIE-OOP.21 Object-Oriented Programming Z,ZK 5 Object-oriented programming has been used in the last 50 years to solve computational problems by using graphs of objects that collaborate together by message passing. In this course students get acquainted with the main principles of object-oriented programming and design, used in modern programming languages. The emphasis is on practical techniques for developing software, which includes testing, error handing, refactoring, and application of design pattern. BIE-OSY.21 Operating Systems Z,ZK 5 In this course that is a follow-up of the Unix-like operating systems course students deepen their knowledge in areas of OS kernels, process and thread implementations, race conditions, critical regions, thread scheduling, shared resource allocation and deadlocks, management of virtual memory and data storages, file systems, OS monitoring. They are able to design and implement simple multithreaded applications. General principles are illustrated on operating systems Solaris, Linux, or MS Windows BIE-PA1.21 Programming and Algorithmics 1 Z,ZK Students learn to construct algorithms for solving basic problems and write them in the C language. They master data types (simple, pointers, structured), expressions, statements, and functions presented in C language. They understand the principle of recursion and basics of algorithm complexity analysis. They know fundamental algorithms for searching, sorting, and manipulating linked lists and trees. BIE-PA2.21 Programming and Algorithmics 2 Z.ZK Students know the instruments of object-oriented programming and are able to use them for specifying and implementing abstract data types (stack, queue, enlargeable array, list, set, table). They learn these skills using the C++ programming language and are introduced to all C++ features needed in object-oriented programming (e.g., template programming, copying/moving of objects, operator overloading, inheritance, polymorphism). **BIE-PJP** Programming Languages and Compilers Z,ZK Students master basic methods of implementation of common high-level programming languages. They get experience with the design and implementation of individual compiler parts for a simple programming language: data types, subroutines, and data abstractions. Students are able to formally specify a translation of a text that has a certain syntax into a target form and write a compiler based on such a specification. The notion of compiler in this context is not limited to compilers of programming languages, but extends to all other programs for parsing and processing text in a language defined by a LL(1) grammar. **BIE-PJV** Z,ZK Programming in Java 4 The course Programming in Java will introduce students to the object oriented programming in Java programming language. Beside of basics of Java language the fundamental APIs will also be presented, especially data structures, files, GUI, networking, databases and concurrent APIs. **BIE-PKM Preparatory Mathematics** 4 The purpose of Preparatory Mathematics is to help students revise the most important topics of high-school mathematics Practical Digital Design **BIF-PNO** ΚZ 5 Students get an overview of the contemporary digital design flow and learn practical skills to use synchronous design techniques. They understand the basics of the VHDL language. and implementation technologies FPGA and ASIC. **BIE-PPA** Programming Paradigms Z,ZK 5 BIE-PRR.21 Project management Z,ZK 5 The aim of the course is to introduce students into the basic concepts and principles of project management, i.e. methods of planning, teamwork, analysis, crisis management in a project, communication, argumentation and meeting management. Students will practice project management techniques (e.g. SWOT analysis, risk assessment and management, Gantt charts, resource schedule, resource balancing, network graphs) and creation of project documentation. The course is designed especially for students who are interested in deepening their knowledge outside IT, consider starting their own company, or have ambitions to work in middle or senior management positions in large companies. The course is also suitable for all those who will develop software or hardware in the form of team projects. BIE-PS2 Programming in shell 2 Z.ZK 4 Students get a general overview of scripting languages, introduction into syntax, semantics, programming style, data structures, pros and cons. In addition, they gain a deeper insight into Bourne Again shell and some other particular scripting languages and will get practical experience with shell script programming. Note to Erasmus students: We are ready do adapt the lectures to provide even very basic Bourne shell usage. Depending on actual knowledge of the students, orientation in user filesystem tools (cp, ln, mkdir, rm...) and useful basic data filtering tools (cut, tr, sort, uniq...) can be provided. The advantage of this module is that we do not stop at this point - we will show you also a selection of advanced scripting techniques used in practice. BIE-PSI.21 Z,ZK Computer Networks 5 The course introduces students to the principles of computer networking. It covers basic technologies, protocols, and services commonly used in local networks and in the Internet as well. The lectures will be amended by proseminars that introduce students into network programming and demonstrate the abilities of advanced network technologies. Students practically verify configurations and management of network devices in the lab within the environment of the operating systems Linux and Cisco IOS. BIE-PST.21 Probability and Statistics Z.ZK Students will learn the basics of probabilistic thinking, the ability to synthesize prior and posterior information and learn to work with random variables. They will be able to apply basic models of random variable distributions and solve applied probabilistic problems in informatics and computer science. Using the statistical induction they will be able to perform estimations of unknown distributional parameters from random sample characteristics. They will also be introduced to the methods for testing statistical hypotheses and determining the statistical dependence of two or more random variables. BIE-SAP.21 Computer Structures and Architectures Z,ZK 5 Students understand basic digital computer units and their structures, functions, and hardware implementation: ALU, control unit, memory system, inputs, outputs, data storage and transfer. In the labs, students gain practical experience with the design and implementation of the logic of a simple processor using modern digital design tools Computer Engineering Seminar I The Seminar of Computer Engineering is a (s)elective course for students who want to deal with deeper topics of digital design, reliability and resistance to failures and attacks. Students are approached individually within the subject. Each student or group of students solves some interesting topic with the selected supervisor. Part of the subject is work with scientific articles and other professional literature and/or work in K N laboratories. The capacity of the subject is limited by the possibilities of the seminar teachers. The topics are new for each semester. BIE-SCE2 Computer Engineering Seminar II Ζ The Seminar of Computer Engineering is a (s)elective course for students who want to deal with deeper topics of digital design, reliability and resistance to failures and attacks. Students are approached individually within the subject. Each student or group of students solves some interesting topic with the selected supervisor. Part of the subject is work with scientific articles and other professional literature and/or work in K N laboratories. The capacity of the subject is limited by the possibilities of the seminar teachers. The topics are new for each semester. **BIE-SEG** Systems Engineering 7 This is an introductory class on systems engineering for bachelor students in computer science. The goal of the class is to introduce basic principles of operating systems for students to understand processor and memory virtualization. Seeing and actually understanding virtualization is the overarching theme of the class. After taking the class, students are able to understand the difference between processes and threads as well as emulation and virtualization, what virtual memory is and how it works, what concurrency is, as opposed to parallelism, and how processes and threads synchronize efficiently to overcome concurrency for communication.

BIE-SEP World Economy and Business Z,ZK The course introduces students of technical universities to international business. It does that predominantly by comparing individual countries and key regions of the world economy. Students get to know about different religions and cultures, necessary for doing business in diverse societies as well as indexes of economic freedom, corruption and economic development, which are needed for the right investment decision. Seminars help to improve knowledge in the form of discussions based on individual readings BIE-SIP.21 **Network Programming** 5 The course covers fundamental topics of programming network applications. It consists of 4 parts. The introductory part is focused on low-level programming using BSD sockets. The second part is devoted to designing communication protocols and their verification. The third part introduces the principles and applications of middleware technologies. The final part introduces basic modern models of distributed computing - P2P and blockchain. All topics will be first explained theoretically and then practices in computer labs using a chosen programming language environment. BIE-SKJ.21 Scripting Languages Join us on a tour into the world of scripted programming. Together, we will unveil the power of Bourne Again shell and PERL as proven industry standards, as well as a couple of other standard text processing utilities (AWK, sed), with some basic UNIX system tools, in many real-world situations like processing web feeds or logs. We will provide a general overview of scripting languages and introduction into their pros and cons and students get practical experience with shell script programming. We will touch also ROFF, PerlDoc, and even TeX to get some insight into how your code documentation can be implemented. And if you know UNIX system-level scripting already, we can show you advanced programming techniques and tricks that get overlooked frequently but increase code robustness or execution efficiency. The course is led by two veteran programmers in the scripting world. Lukáš is a renowned lecturer in advanced shell programming, teaching developers from the IT industry in several CE countries. Jan is a skilled lecturer and developer whose code contributes to safe and streamline operations of cloud service datacenters around the globe. BIE-SP1.21 Team Software Project 1 ΚZ 5 Students gain hands-on experience with the analysis, design, and prototyping of a large-scale software system. Theoretical support is provided in the BIE-SWI course that runs concurrently and that teaches students necessary techniques and principles. Teams consisting of 4-6 students will work on a specific project. The teacher, in the role of the team and project leader, regularly consults with the team (at the seminars) both the formal and material aspects of the software design. The resulting software artefact will be further developed and finished in the BIE-SP2 course. BIE-SP2.21 Team Software Project 2 Students gain hands-on experience with the iterative development process while working on a large-scale software project. The first iteration is the result of the BIE-SP1 course project. However, in this follow-up, the functionality, testing, and documentation of the software system being developed will be emphasized. Students will work in teams of 4-6 people. The teacher, in the role of the team and project leader, regularly consults with the team (at the seminars) the formal as well as material aspects of their solution. BIE-SPS.21 Administration of Computer Networks and Services The aim of the course is to deepen the theoretical knowledge of network technologies and protocols in the environment of network servers administrated under the operating systems Linux and Windows. The course syllabus requires the knowledge at the level of courses BIE-PSI, BIE-VPS, and BIE-OSY. Practical skills will be gained by practical hands-on experience with real network infrastructure. BIE-SRC.21 Real-time systems Z,ZK Students obtain the basic knowledge in the real-time (RT) system theory and in the design methods for RT systems including the dependability issues. Theoretical knowledge from lectures will be experimentally verified in department specialized labs. The course is mainly focused on embedded RT systems, therefore the design kits in the lab are the same as in the BIE-VES course and FPGAs.. BIE-ST1 Network Technology 1 Ζ 3 P edm t je zam en na získání základních znalosti z oblasti po íta ových sítí a praktických zkušeností se sí ovými technologiemi. P edm t odpovída látce kurikula Cisco Netacad programu - CCNA1 - R&S Introduction to Networks. Software Engineering Students get acquainted with methods of analysis and design of larger software projects that are typically designed and implemented in teams. They consolidate and practically verify their knowledge during the analysis and design of larger software systems that will be developed in the concurrent course BIE-SP1. Students get hands-on experience with CASE tools using the visual language UML for modeling and solving software problems. Students learn the basics of object-oriented analysis, architecture design and testing. Within the course, students also gain a theoretical basis in the field of project management, estimation of costs of software projects, and methods of their development. BIE-TAB.21 Applications of Security in Technology Z,ZK 5 The goal of the course is to introduce students to selected topics from cybersecurity technical applications that are utilized in different industries. Students get a broader overview of cybersecurity applications and extend their knowledge from the cryptology, the secure code, and system, network, and hardware security. **Documentation and Presentation** BIF-TDP21 3 The course is focused on the basics of creating electronic documentation with emphasis on the creation of technical reports of a larger scope, typically final university theses. Students learn to create text of a technical report in the LaTeX system, process an electronic presentation using the LaTeX Beamer system, and practically present it in front of classmates and the teacher. The course is intended primarily for those students who have chosen the topic of their bachelor's thesis or will choose it within the first 14 days of teaching. Within the exercises of the course, an active approach to the creation of individual parts of the bachelor's thesis is assumed. Java Technology The aim of the course is to provide knowledge and skills needed for the development of smaller and larger information systems. Students will get acquainted with general theoretical concepts and will be able to apply these concepts using libraries and tools from the ecosystem of the Java programming language. After completing the course students will be able to participate in the development of software systems on the Java platform. Students are assumed to be acquainted with the following topics (they are used and not taught in this course): Java language syntax, SQL, git version control system, Docker, continuous integration. BIE-TPS.21 Computer Networks Technologies Z,ZK The course introduces students with basic and advanced technologies, components, and interfaces of contemporary computer networks at the physical layer with the overlap to the link layer. The lectures provide theoretical foundations of these technologies and explain relevant physical principles. In the labs, the respective technologies will be demonstrated and with the most important ones students will get hands-on experience. Thematically, the course covers both local and long-range optical networks, Ethernet, modern wireless networks, always with focus on high-speed networks. BIE-TUR.21 User Interface Design Z,ZK 5 Students gain a basic overview of methods for designing and testing common user interfaces. They get experience to solve the problems where software and other products do not communicate with the user optimally, since the needs and characteristics of users are not taken into account during product development. Students gain an overview of methods that bring users into the development process to ensure optimal interface for them. BIE-TZP.21 Technological Fundamentals of Computers Z,ZK Students get acquainted with the fundamentals of digital and analog circuits, as well as basic methods of analyzing them. Students learn how computer structures look like at the lowest level. They are introduced to the function of a transistor. They will understand why processors generate heat, why cooling is necessary, and how to reduce the consumption; what the limits to the maximum operating frequency are and how to raise them; why a computer bus needs to be terminated, what happens if it is not; how a computer power supply looks like (in principle). In the labs, students model the behavior of basic electrical circuits in SW Mathematica. BIE-UKB.21 Introduction to Cybersecurity Z.ZK The goal of the course is to provide students with the introduction of basic concepts in modern approach to cybersecurity. Students will get a basic overview of threats in cyberspace and attacker techniques, security mechanisms in networks, operating systems and applications, as well as of basic cyberspace regulations.

BIE-UOS.21	Unix-like Operating Systems	KZ	5
	Systems represent a large family mostly open-source codes that kept bringing during the history of computers efficient innovative fur		_
	ters and their networks and clusters. The most popular OS today, Android, has a unix kernel. Students get overview of basic properti		
-	ids, access rights and user identity, filters, or handling files in a file system. They learn to use practically these systems at the level of		=
	to utilize powerful system tools that are available to users, but are also able to automatize routine agenda using the unix scripting into		
BIE-VAK.21	Selected Combinatorics Applications	7	3
	ntroduce students in an accessible form to various branches of theoretical computer science and combinatorics. In contrast to the ba	_	-
	ons to theory. Together, we will first refresh the basic knowledge needed to design and analyze algorithms and introduce some basic		
	cipation of students, we will focus on solving popular and easily formulated problems from various areas of (not only theoretical) info		
•	s to be solved will include, for example, graph theory, combinatorial and algorithmic game theory, approximation algorithms, optimiza		
	also try to implement solutions to the studied problems with a special focus on the effective use of existing tools.		
BIE-VDC.21	Virtualization and Data Centers	Z,ZK	5
he aim of the course	e is to familiarize students with technology basis of cloud computer systems. It shows principles and techniques used in design and i	implementation of	of data cente
nfrastructure, such	as various kinds of virtualization and high availability of servers, storages, and software layers. The course guides through data central course guides and course guides through data central course guides and course guides guides and course guides	ter technologies	from private
	d clouds. Student learn current trends in the architecture of IT infrastructure and its configuration for classic and cloud applications. S		
design, validati	ion, and operation of complex infrastructures for modern applications with respect to scalability and protection against overloads, ou	itages, and data	losses.
BIE-VES	Embedded Systems	Z,ZK	5
tudents learn to des	sign embedded systems and develop software for them. They get basic knowledge of the most common microcontrollers and embedde	ed processors, th	eir integrate
	peripheral circuits, programming methods, and applications. They get practical skills with development kits and tools.		
BIE-VES.21	Embedded Systems	Z,ZK	5
tudents learn to des	sign embedded systems and develop software for them. They get basic knowledge of the most common microcontrollers and embedde	ed processors, th	eir integrate
	peripheral circuits, programming methods, and applications. They get practical skills with development kits and tools.		_
BIE-VMM	Selected Mathematical Methods	Z,ZK	4
•	with an introduction to the analysis of complex functions of a complex variable. Next, we present the Lebesgue integral. We then add		
•	we introduce and study the properties of the Discrete Fourier Transform (DFT) and its fast implementation (FFT). We discuss the wa		We examin
	e linear programming problem in more detail and its solution using the Simplex algorithm. Each topic is demonstrated with interesting	<u> </u>	1
BIE-VPS.21	Selected Topics in Computer Networking	Z,ZK	5
-	on the Computer Networks course (BI-PSI), obligatory for the program. Students will learn in detail principles, protocols, and technolog	_	-
	area networks up to Internet, with focus on switching, routing, security, and virtualization. The emphasis will be on gaining practical	-	real networ
devid	ces in the lab and learning important methods of local area and wide area networks from the viewpoint of functionality, performance,	, and security.	_
	Virtual reality I	KZ	4
ntroduction to Virtu	ual Reality (VR), virtual reality operations, metaverse, and creation. Rules and requirements for virtual worlds communication. The co	ourse focuses on	1
Introduction to Virtu	al Reality (VR), virtual reality operations, metaverse, and creation. Rules and requirements for virtual worlds communication. The cocreating virtual reality worlds and interactive activities in 3D worlds. It improves computational thinking, empathy, and shared social	ourse focuses on activities.	the ways of
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FITE-EHD	Introduction to European Economic History	Z,ZK	3	
The course introduc	The course introduces a selection of themes from European economic history. It gives the student basic knowledge about forming of the global economy through the description of the			
key historical perio	key historical periods. As European countries have been dominant actors in this process it focuses predominantly on their roles in economic history. From the large economic area of			
the Roman Empir	e to the fragmentation of the Middle Ages, from the destruction of WWII to the current affairs, the development of modern financial in	stitutions is deciph	nered. The	
course does not co	over the detailed economic history of particular European countries but rather the impact of trade and the role of particular events, ins	stitutions and orga	nizations in	
	history. Class meetings will consist of a mixture of lectures and discussions.			
FITE-SEP	World Economy and Business	Z,ZK	4	
The course introduces students of technical universities to international business. It does that predominantly by comparing individual countries and key regions of the world economy.				
Students get to know about different religions and cultures, necessary for doing business in diverse societies as well as indexes of economic freedom, corruption and economic				
development, which are needed for the right investment decision. Seminars help to improve knowledge in the form of discussions based on individual readings.				
TV2K1	T lesná výchova 2	Z	1	
TVKLV	T lovýchovný kurz	Z	0	
TVV	T lesná výchova	Z	0	
TVV0	T lesná výchova 0	Z	0	
UKCJP	eština pro pokro ilé	Z,ZK	2	
Kurz pokro ilé eštiny pro ukrajinské studenty, kte í mají status uprchlíka. Zkouška potvrdí znalost eštiny na úrovní B2 s platností pro VUT.				

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